Paper ID: 98988
student

53rd IAF STUDENT CONFERENCE (E2)
Student Conference - Part 1 (1)

Author: Mr. Josef Richmond
Australian National University (ANU), Australia

Dr. Joshua Machacek
Australian National University (ANU), Australia
Prof. Christine Charles
Australian National University (ANU), Australia
Prof. Rod Boswell
Australian National University (ANU), Australia

PHOTOELECTRIC REMOVAL OF CHARGED REGOLITH DUST FROM CONTAMINATED SURFACES

Abstract

The accumulation of charged regolith dust on surfaces such as spacesuit materials presents a major challenge for long-term human and robotic operations on the Moon and other airless bodies. Dust particles, which become electrostatically charged through photoemission and interactions with ambient plasma, adhere to surfaces, degrading the performance of mechanical, thermal, and optical systems. In this work, we demonstrate the removal of charged dust particles from a contaminated surface by intense vacuum ultraviolet (VUV) irradiation.

The source of VUV radiation used in this experiment was an inductively coupled, radiofrequency plasma that emits quasi-monochromatic Lyman-α (121.6 nm) radiation, with fluxes on the order $10 - 50$ mW/cm^2 measured at the dusty surface. To simulate the Solar wind plasma, a low-density plasma was also generated in the chamber via a thoriated tungsten filament in argon gas. Plasma densities on the order of 10^{-6} cm^{-3} were measured via a planar Langmuir probe. Several surface materials, including Kapton, Beta Cloth and borosilicate glass were pre-loaded with JSC-1A regolith simulant of 40-70 μm diameter. The mobilisation of dust particles was recorded via video camera, and relative charge measurements pre- and post-irradiation were made via a biased mesh grid. The dust removal efficiency was quantified by weighing the Beta cloth pre- and post-irradiation.

Mobilisation rates were found to vary significantly with ambient plasma conditions and VUV fluxes. Larger VUV fluxes were shown to increase the mobilisation rate, which was further increased by the addition of the background, low-density plasma, consistent with observations of photoelectric charge pumping of dust particles in the literature. Based on these observations, we present a high-intensity VUV source for in-situ removal of regolith dust contaminating various surfaces including spacesuits, thermal radiators and solar panels.